

**APPENDIX A
DRAFT ENGINEER REGULATION 1110-2-109**

DRAFT 10/23/97

**DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000**

ER 1110-2-109

CECW-EE

Regulation
No. 1110-2-109

15 April 1998

**Engineering and Design
HYDROELECTRIC DESIGN CENTER**

1. Purpose

This regulation designates the U.S. Army Corps of Engineers District, Portland, Hydroelectric Design Center (HDC), as the Mandatory Center of Expertise (MCX) for hydroelectric power and pumping plant design. It also prescribes the requirements for use of HDC by the U.S. Army Corps of Engineers (USACE) commands and establishes policy and provides guidance for interfacing the resources of HDC with those of the requesting USACE command.

2. Applicability

The regulation is applicable to all HQUSACE elements, major subordinate commands, districts, laboratories, and field operating activities having civil works operation and maintenance (O&M), construction, and planning and/or design responsibility for hydroelectric plants and/or pumping plants.

3. References

- a.* ER 5-1-10, Corps-wide Areas of Work Responsibility.
- b.* ER 1110-1-5158, Corps-wide Centers of Expertise Program
- c.* ER 1110-2-1150, Engineering and Design for Civil Works Projects.

This regulation supersedes ER 1110-2-109, 15 April 1993

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d. ER 1110-2-1200, Plans and Specifications.

e. ER 1110-2-4402, Station Service Power

f. ER 1110-2-1454, Corps Responsibilities for Non-Federal Hydroelectric Power Development Under the Federal Power Act.

4. Policy

In accordance with the requirements of ER 1110-1-8158, HDC is established as an MCX responsible for hydroelectric power and pumping plant engineering and design work. All work identified hereinafter shall be executed, reviewed or otherwise controlled in accordance with ER 1110-1-8158 and ER 5-1-10. The planning and engineering for hydroelectric power and large pumping plant projects require highly specialized expertise. The decreasing hydroelectric power and large pumping plant workload within the USACE makes it necessary to consolidate that workload at a centralized office to preserve the Corps' expertise in these fields. The capability and expertise to execute this highly specialized work now exist within HDC. HDC will maintain, within the Corps, the capability and proficiency required for the planning, engineering, design, and criteria development for all existing and new hydroelectric power plants and large pumping plants. For purposes of this document, a large pumping plant is defined to have a total station capacity equal to or greater than 30 cubic meters per second.

5. Responsibilities

a. HQUSACE. The Chief of Engineering Division, Civil Works Directorate (CECW-E), is assigned the overall oversight responsibility of HDC. The HQUSACE proponent, responsible for the duties identified in ER 1110-1-8158, is the Chief(CECW-E_).

b. USACE Command.

(1) The USACE command responsible for managing the project will:

a. Obtain the services of HDC for the work listed in paragraph 6.

b. Retain overall project responsibility including funding, scheduling, contract management, and inspection.

c. Coordinate all scheduling with that of HDC at the earliest practical date. This date will be 3 to 6 months prior to submitting budgetary line items for which HDCs services will be required, unless other arrangements are made. The development of any schedule must take into account

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prior commitments of HDC. Any scheduling conflicts will be resolved by CECW-E.

d. Coordinate with HDC, at the time of initial scheduling, the development of a scope of work in sufficient detail to permit HDC to prepare a preliminary cost estimate of the required engineering services and to update the schedule and cost estimate prior to commencement of the work. Funds need to be provided to HDC for its participation in this development phase of the work.

e. Fund HDC for the services to be performed and furnish necessary project information in time to permit HDC to complete the design on schedule.

f. Execute the construction or repair of the powerhouse and pumping plant and procure and install the equipment.

g. Keep HDC informed of all anticipated changes to the completed design. Changes will be made only if jointly agreed to by HDC and the requesting USACE command. If a conflict or difference develops that cannot be resolved by mutual agreement between the parties involved, HQUSACE (CECW-E) will be notified and requested, by either party, to assist in resolution of the conflict or difference. HQUSACE (CECW-E) will have the final decision to resolve these conflicts or differences.

(2) The USACE command shall notify HDC of required emergency services and coordinate in-house resources with those of HDC. Emergency services are defined as design, preparation of contract documents, or consultation services necessary to restore or replace failed power plant equipment to full operational capability.

(3) Routine maintenance and repair shall remain the responsibility of the requesting USACE command. Failure analysis, including testing and evaluation of major equipment, will remain with the requesting USACE command but should be coordinated with and reviewed by HDC.

(4) When the work done by HDC becomes part of a larger contract or design document, the USACE command will furnish HDC the completed contract or design document for review to ensure proper coordination of HDC's work.

(5) All engineering and design functions not listed in paragraph 6, e.g., hydraulic and hydrologic, and geotechnical, will remain the responsibility of the USACE command.

c. Hydroelectric Design Center.

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(1) HDC has been assigned mission responsibility for providing engineering services to the requesting USACE command for hydroelectric power and pumping plants. If unable to perform, due to scheduling conflicts, HDC has the option to use A-E services or other available and capable USACE commands to accommodate the schedule of the requesting USACE command. HDC can also use resident expertise at Corps laboratories to perform physical or numerical model studies. If A-E services are used, the USACE command may require HDC to charge such services to a direct fund cite provided by the command.

(2) HDC will furnish to the requesting USACE command the best possible cost estimate commensurate with the scope of work provided and the best possible technical design consistent with the stated requirements of the project. HDC will coordinate its design efforts with the requesting USACE command and will keep that USACE command fully informed regarding the pertinent features and status of the design through monthly progress reports.

(3) Prior to commencing work, HDC will review with the requesting USACE command the latest scope of work to ensure that there is agreement and understanding on content, schedule, and cost. A written agreement will then be prepared by HDC confirming the work to be accomplished, the schedule, and the cost. HDC will keep the requesting USACE command informed about problems which could delay completion of the design or impact other aspects of the project. If needed and after consultation with the requesting USACE command, HDC may establish priorities based on workload and project requirements. However, emergency services as defined above will always have high priority.

(4) HDC will be responsible for performing an independent review and approval of all its work.

(5) HDC will report to the assigned HQUSACE proponent the quarterly status of the work being performed and of the anticipated future workload. HDC will also provide the proponent updated electronic data for posting on the HQUSACE homepage. The data will include information identified in ER 1110-1-8158.

d. Portland District. The U.S. Army Corps of Engineers, Portland District is responsible for day-to-day administrative oversight and administrative support of HDC. This will include, but not be limited to, providing contracting, logistics, counsel, and personnel support. The Director of HDC will report to the district commander.

6. Work to be Performed by HDC

This paragraph describes both the mandatory services that must be performed by HDC and optional services that will be performed by the HDC if requested by HQUSACE or a USACE command.

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a. Mandatory services. Except for responsibilities, as defined in paragraph 5, which remain at the USACE command, HDC will have mission responsibility to provide engineering services for all hydroelectric work critical to the generation of power and for all large pumping plants. This includes all new facilities, existing facilities, major modifications, expansion, non-routine maintenance and rehabilitation of large pumping plants and hydroelectric facilities whether Corps owned or whether the Corps is requested by others to provide such services. Items that are critical to the generation of power and the level of HDC involvement are identified in Appendix A. HDC must do the following:

(1) Prepare the electrical and mechanical portions of reconnaissance reports and other preauthorization studies; preliminary design reports and design memoranda; preliminary cost estimates and studies for uprating, rehabilitation, or replacement of equipment or systems.

(2) Perform the electrical and mechanical design for pumping stations and powerhouses including switchyards, related facilities, and all hydraulic transient studies for water passages of hydroelectric and pumping facilities.

(3) Provide structural engineering services to coordinate the plant layout, foundation support for mechanical and electrical equipment and crane requirements with other technical disciplines.

(4) Prepare contract plans and technical specifications. Assist the requesting command in preparing the non-technical portions of the contract documents and the construction cost estimate.

(5) Provide technical review of shop drawings.

(6) Provide technical assistance to the Contracting Officer's Representative during contract period and at all shop and field tests, including model tests. Analyze results, make recommendations, and provide engineering services during construction.

(7) In accordance with ER 1110-2-1454, review the structural and mechanical features of non-Federal hydropower at Corps projects that could affect the integrity and safety of Corps projects.

(8) In accordance with ER 1110-2-4402, HDC will provide engineering and design services for the planning and installation of station service hydroelectric units.

b. Optional services. At the request of a USACE command or HQUSACE, HDC must perform the following services:

(1) Prepare or assist in preparation of O&M manuals.

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- (2) Provide support for hydroelectric and pumping plant training programs involving engineering and design.
- (3) Provide support to HQUSACE or USACE commands on hydroelectric and pumping plant matters. This includes preparation of new criteria, update/revision of existing criteria, and execution of special studies to determine equipment condition indicators and/or reliability projections.
- (4) Assist in periodic inspections.
- (5) Test and evaluate the performance and condition of existing major equipment to determine whether replacement or rehabilitation is necessary.
- (6) USACE commands can assign COR authority to HDC for approving technical submittals, witnessing and approving model tests, and witnessing and approving major equipment field performance tests.
- (7) Conduct failure analyses for major equipment.
- (8) Perform engineering services for pumping plants regardless of plant size.
- (9) Review testing and evaluation, performed by others, of existing major hydroelectric equipment performance to determine whether replacement or rehabilitation is necessary.
- (10) Review and coordinate major equipment failure analyses performed by USACE commands.
- (11) Provide engineering services for non-critical hydropower equipment.
- (12) Revise contract drawings to reflect "as-built" conditions.

7. Method of Operation

The following lists HDC's method of operation and specific operational requirements for both HDC and the requesting USACE command.

a. General. HDC will evaluate requests from USACE commands and will assign engineering functions to maximize its resources and maintain its technical capability and expertise.

b. Activity scheduling. Each year in February, HDC will request Commanders of the USACE commands, having responsibility for Civil Works projects, to provide the best estimate of their

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anticipated needs for HDC services in terms of project dollar value of design effort or assistance for the ensuing 2- to 5-year period. HDC will meet with district representatives in March/April of each year to discuss line items on the O&M budget that could impact HDC's workload.

c. Funding for HDC services. HDC will develop a preliminary cost estimate for design services based on the scope and schedule agreed to between HDC and the requesting USACE command. Any revisions made to the cost estimate must be mutually agreed to by the parties involved. Each USACE command also has the option to establish a "small-on-call" account with HDC. This account will facilitate a rapid response in emergencies and will provide initial funding for the development of scopes of work, schedules and cost estimates. HDC will charge to this account only when specifically authorized by the requesting USACE command and excess funds will be returned in the fourth quarter of each fiscal year.

d. Review and approval process. The review and approval process will be in accordance with the requirements of ER 1110-2-1150 and ER 1110-2-1200.

f. Interoffice communication and coordination. Direct correspondence and communication between HDC and the requesting USACE command are authorized. This is necessary to define scope(s) of work, determine schedule(s) and funding, coordinate the design, and to keep the respective parties fully informed as to the status of the work.

8. Research and Development

Upon direction from CERD, HDC will be responsible to participate in, review, or monitor research and development work unit activities for hydroelectric power plants and pumping plants. HDC will participate with other field users in identifying Civil Works research and development needs. Staff members of HDC will also participate, as members of the Civil Works R&D Field Review Group in their area, in reviewing, advising, and assisting in the technology transfer of research results. HDC may also conduct joint research, development, and demonstration projects with the Corps laboratories as directed by CERD.

9. Water Hammer Studies

HDC can perform water hammer studies for other than hydroelectric and pumping plant water passages.

10. Waiver to this Regulation

The Business Process Council (BPC), established in ER 5-1-10, will review waiver requests and recommend approval or denial of the request to the Chief, Engineering Division, Directorate of

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Civil Works, who has final approval authority.

11. Recertification.

HDC will be recertified as an MCX every two years according to the requirements of ER 1110-1-8158 Appendix A. Six months prior to its recertification date, HDC shall provide the HQUSACE proponent a draft copy of the recertification document as outlined in the above mentioned Appendix.

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Appendix A
Design Responsibility Matrix

New Powerhouses and Pumping Stations:

HDC will be fully responsible for the development of all mechanical and electrical equipment and systems, equipment layout and general structural configuration for all new powerhouses and all new pumping stations over 30 cubic meters per second.

Existing Powerhouses and Pumping Stations:

The level of HDC's involvement in the design of any repair, replacement or modification to major powerhouse or pumping station equipment and systems will vary depending upon the nature of the equipment or system and the extent of the work. The following three levels of involvement will apply to all engineering products including studies, plans and specifications, technical contract administration and failure analysis.

Level 1: HDC is mandatory as technical lead.

Level 2: HDC is mandatory as independent technical reviewer at both conceptual stage and final product stage.

Level 3: Use of HDC is optional at the discretion of the requesting USACE Command.

Definitions:

New or major rehabilitation of existing – Design of equipment and/or systems for new, or rehabilitation of existing powerhouses or pumping stations. Work under this category is either funded by Construction General, or by O&M General in anticipation of receipt of CG funding. Examples: Turbine runner replacement.

Non-routine maintenance, repairs or replacement – Work that is funded by O&M General under a specific line item on the non-routine maintenance budget submittal. Generally this type of work is associated with life extension of the existing equipment or system. Examples: Installing a stainless steel overlay on the turbine discharge ring. Rewinding a generator stator.

Equipment or system modifications – Work involved with changing the configuration or operation of existing equipment or systems. Work in this category is independent of funding and is intended to include relatively minor work performed by operations personnel. Examples: Adding another

source of station service power. Modifying the generator cooling water system to provide multiple sources of supply.

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Replacement in-kind of component parts – Work that does not involve changing equipment configuration or system operations. Generally, this type of work is associated with replacement of a component that is at or near the end of its service life. Examples: Replacement of a governor oil pump and motor with the same design specifications as the original. Replacement of one or more generator stator coils with spares.

The definition and application for the equipment and systems in the matrix are provided in EM 1110-2-4205, EM 1110-2-3006, and EM 1110-2-3001.

Systems not shown:

The design work for systems and equipment not shown in the matrix will remain the responsibility of the requesting USACE command. If the USACE command does not have the expertise for performing this work, HDC can assist in either locating another USACE command with the expertise or selecting an AE firm with appropriate capability. This can include cranes and hoists not used for intake gates or turbine/generator handling, elevators, maintenance shops, water or service air systems, plumbing and HVAC, communications, lighting and receptacle systems and other structural work.

Matrix:

Equipment or System (critical to power generation)	New or major rehabilitation	Non-routine maintenance, repairs/replacement	Equipment or system modifications	Replacement in-kind of component parts
Mechanical				
Turbines	1	1	1	2
Pump/turbines	1	1	1	2
Governors	1	1	1	3
Penstock shutoff valves	1	1	1	2
Main bridge crane system	1	1	1	2
Intake/draft tube gantry crane systems	1	1	1	3
Intake gate hoists	1	1	1	2

Station service engine/generator sets	1	1	1	2
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Generator/transformer/ turbine cooling water systems	1	2	2	3
Unwatering and drainage systems	1	2	2	3
Oil systems	1	2	2	3
Brake air system	1	2	2	3
Governor air system	1	1	1	3
Draft tube depression air system	1	2	1	3
CO ₂ fire protection system (non-generator)	1	2	2	3
Generator fire protection system	1	1	1	3
Transformer deluge system	1	2	2	3
Piezometers, flowmeters, and water level gauges	1	1	1	3
HVAC using generator cooling water	2	2	2	3
Control room HVAC	2	2	2	3
Electrical				
Generator	1	1	1	2
Motor/generator	1	1	1	2
Basic electrical switching provisions	1	1	1	2
Power transformers	1	1	1	2
High voltage systems	1	1	1	2
Generator voltage system	1	1	1	2

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Station service system	1	1	1	2
Control system	1	1	1	2
Annunciation system	1	1	2	3
Direct current system	1	1	1	2
Grounding system	1	1	1	2
Structural				
Draft tube	1	2	2	-
Spiral case	1	2	2	-
Generator Pedestal	1	2	2	-
Turbine support	1	2	2	-
Superstructure	1	2	2	-
Intakes	1	2	2	-
Penstocks and surge tanks	1	2	2	-
Switchyard structures	1	2	2	-
Penetrations of existing structures	1	2	2	-